AD-A062 461

SRI INTERNATIONAL MENLO PARK CA
MECHANISMS OF MULTIPHOTON DISSOCIATION OF MOLECULAR IONS.(U)
DEC 78 M J COGGIOLA, J R PETERSON N00014-76-CSRI-MP-78-123 N00014-76-C-1035

UNCLASSIFIED









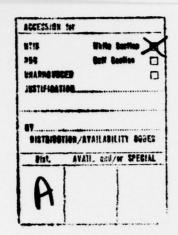
END DATE FILMED 3 -79

DDC

REPORT DUCUMENTATION PAGE 2. GOVT ACCESSION NO. 3. RECIPIENT'S CATALOG NUMBER 3. TYPE (and Subtitle) Mechanisms of Multiphoton Dissociation of Molecular Ions . Mechanisms of Multiphoton Dissociation of Molecular Ions . SRI — MP-78-123 Michael J. Coggiola and J. R. Peterson Michael J. Coggiola and J. R. Peterson D. PERFORMING ORGANIZATION NAME AND ADDRESS SRI International . 333 Ravenswood Avenue Menlo Park, CA.94025 D. Controlling Office of Naval Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And Address of Manal Research 800 North Quincy Street And And And And Address of Manal Research 800 North Quincy Street And And And And Address of Manal Research 800 North Quincy Street And And And And And Address of Manal Research 800 North Quincy Street And And And And And Address of Manal Research 800 North Quincy Street And And And And And Address of Manal Research 800 North Quincy Street And	SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)	READ INSTRUCTIONS
Mechanisms of Multiphoton Dissociation of Molecular Ions . Mechanisms of Multiphoton Dissociation of Molecular Ions . Nathorical J. Coggicia and J. R. Peterson SRI . PERFORMING aga. REPORT IN . MP-78-123 PERFORMING ORGANIZATION HAME AND ADDRESS SRI International . 333 Ravenswood Avenue Menlo Park, CA. 94025 Office of Naval Research . 800 North Quincy Street	REPORT DOCUMENTATION PAGE	BEFORE COMPLETING F
Mechanisms of Multiphoton Dissociation of Molecular Ions. Mechanisms of Multiphoton Dissociation of Molecular Ions. March 1978-November March 19	1. REPORT NUMBER 2. GOVY ACCESSION A	J. RECIPIENT'S CATALOG NUMBE
March 1978-November of Molecular Ions . March 1978-November of Molecular Ions . March 1978-November . PREFORMING ORGANIZATION NAME AND ADDRESS SRI International . SRI Intern	4. TITLE (and Subtitio)	S. TYPE OF REPORT & PERIOD C
ANTHORICS ANTHORICS ANTHORICS D. PERFORMING ORGANIZATION NAME AND ADDRESS SRI International, 333 Ravenswood Avenue Menlo Park, CA.94025 D. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research 800 North Quincy Street Aplington VA 22217 Approved for public release; distribution unlimited. D. DETRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report) B. SUPPLEMENTARY NOTES D. KEY WORDS (Continue on reverse side if necessary and identify by Mock number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics D. AMSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ic will be studied to characterize the details of the process. Ion fragments	Mechanisms of Multiphoton Dissociation	
Michael J. Coggiola and J. R. Peterson Performing Organization name and Address SRI International 333 Ravenswood Avenue Menlo Park, CA.94025 Controlling Office of Naval Research 800 North Quincy Street Aplington VA 22217 Monitoring Agercy name a Address(if different from Controlling Office) Approved for public release; distribution unlimited. DEC 20 19 REV WORDS (Continue on reverce side if necessary and identify by Neck number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics Approved to characterize the details of the process. Ion fragments Approves. In process. Ion fragments Approved. Continue on reverce side if necessary and identify by bleck number) The dynamics of multiphoton absorption and dissociation of polyatomic ic will be studied to characterize the details of the process. Ion fragments	of Molecular Ions .	
Michael J. Coggiola and J. R. Peterson Description De	7.SRI	
PERFORMING ORGANIZATION HAME AND ADDRESS SRI International 333 Ravenswood Avenue Menlo Park, CA.94025 10. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research 800 North Quincy Street Aplinaton VA 22217 13. NUMBER OF PAGES Approved for public release; distribution unlimited. DEC. 20 IS OBSTRIBUTION STATEMENT (of the abstract entered in Block 29, If different from Report) In December 1978 Supplementary notes E. REY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics O AMSTRIAL (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic iowill be studied to characterize the details of the process. Ion fragments	7. AUTHOR(e)	S. CONTRACT OR GRANT NUMBER
SRI International, 333 Ravenswood Avenue Menlo Park, CA. 94025 11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research 800 North Quincy Street Allington VA 2217 12. MONITORING AGERCY NAME & ADDRESS(II different from Controlling Office) Approved for public release; distribution unlimited. 13. SECURITY CLASS. (of this report Unclassified 13. DECLASSIFICATION/DOWNGR SCHEDULE 14. DECLASSIFICATION/DOWNGR SCHEDULE 15. SECURITY CLASS. (of this report Unclassified 15. DECLASSIFICATION/DOWNGR SCHEDULE 16. DISTRIBUTION STATEMENT (of this abstract entered in Block 20, If different from Report) 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, If different from Report) 18. SUPPLEMENTARY NOTES 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics 19. ARSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ion will be studied to characterize the details of the process. Ion fragments	Michael J. Coggiola and J. R. Peterson	NØØØ14-76-C-1Ø35
333 Ravenswood Avenue Menlo Park, CA.94025 11. Controlling Office of Naval Research 800 North Quincy Street Arlington V 22217 12. MEPORT DATE December 1978 13. NUMBER OF FACES Unclassified 14. SECURITY CLASS. (et this report) Approved for public release; distribution unlimited. 15. DECLASSIFICATION/DOWNGR 16. DISTRIBUTION STATEMENT (et the abstract entered in Block 20, if different from Report) 17. DISTRIBUTION STATEMENT (et the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES 19. REY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics 18. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic iowill be studied to characterize the details of the process. Ion fragments		10. PROGRAM ELEMENT, PROJECT
Menlo Park, CA.94025 1. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research 800 North Quincy Street Antington VA 22217 13. MONITORING AGERCY NAME & ADDRESS(II different from Controlling Office) Approved for public release; distribution unlimited. DEC 20 19 7. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, II different from Report) B. SUPPLEMENTARY NOTES 8. SUPPLEMENTARY NOTES 8. REY WORDS (Continue on reverse side If necessary and Identify by Nock number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics 9. ANSTRACT (Continue on reverse side If necessary and Identify by Nock number) The dynamics of multiphoton absorption and dissociation of polyatomic iowill be studied to characterize the details of the process. Ion fragments		10 + for
Office of Naval Research 800 North Quincy Street Anlington V 29217 MONITORING AGERCY NAME & ADDRESS(II different from Controlling Office) Approved for public release; distribution unlimited. DEC 20 19 7. DISTRIBUTION STATEMENT (of the aborract entered in Block 20, II different from Report) B. SUPPLEMENTARY NOTES REY WORDS (Continue on reverse side If necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics D. ARSTRACT (Continue on reverse side If necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic iowill be studied to characterize the details of the process. Ion fragments		Mepc. To 28.
Office of Naval Research 800 North Quincy Street Aligaton VA 22217 MONITORING AGERCY NAME & ADDRESS(II different from Controlling Office) Approved for public release; distribution unlimited. OSTRIBUTION STATEMENT (of the abstract entered in Block 20, If different from Report) P. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, If different from Report) Supplementary notes REY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics O ARSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic iowill be studied to characterize the details of the process. Ion fragments		Wax - NON (s)
800 North Quincy Street Arlington VA 22217 18. SECURITY CLASS. (of this repo Unclassified 18. DECLASSIFICATION/DOWNER SCHEDULE Approved for public release; distribution unlimited. 7. DISTRIBUTION STATEMENT (of the abetract entered in Block 20, if different from Report) 8. SUPPLEMENTARY NOTES 8. SUPPLEMENTARY NOTES 9. KEY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics 9. Approach (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic iowill be studied to characterize the details of the process. Ion fragments	/ 111	4 December 4. 1978
APPLIANCE OF THE WARDS (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic icw will be studied to characterize the details of the process. Ion fragments		
Approved for public release; distribution unlimited. 7. DISTRIBUTION STATEMENT (of the abstract entered in Black 20, if different from Report) 8. SUPPLEMENTARY NOTES 9. KEY WORDS (Continue on reverse side if necessary and identify by black number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics 10. Applementary (Continue on reverse side if necessary and identify by black number) The dynamics of multiphoton absorption and dissociation of polyatomic ions will be studied to characterize the details of the process. Ion fragments		3
Approved for public release; distribution unlimited. DEC 20 19 DEC 20 19 DEC 20 19 NEY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics D. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic iowill be studied to characterize the details of the process. Ion fragments	14. MONITORING AGENCY NAME & ADDRESS(II different from Controlling Office)	15. SECURITY CLASS. (of this repo
Approved for public release; distribution unlimited. 7. DISTRIBUTION STATEMENT (of the abstract entered in Black 20, 16 different from Report) 8. SUPPLEMENTARY NOTES 8. KEY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics 9. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ion will be studied to characterize the details of the process. Ion fragments	60.77	Unclassified
Approved for public release; distribution unlimited. DEC 20 19 DEC 20 19 SUPPLEMENTARY NOTES KEY WORDS (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics ARSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ion will be studied to characterize the details of the process. Ion fragments	(12) 4p.)	18. DECLASSIFICATION/DOWNGR
DEC 20 19 DEC 20 19 DEC 20 19 Supplementary notes Key words (Continue on reverse cide if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics Asstract (Continue on reverse cide if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ions will be studied to characterize the details of the process. Ion fragments	6. DISTRIBUTION STATEMENT (of this Report)	
DEC 20 19 DEC 20		DD
DISTRIBUTION STATEMENT (of the abetract entered in Block 20, if different from Report) Supplementary notes Key words (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics Asstract (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic io will be studied to characterize the details of the process. Ion fragments	Approved for public release; distribution unlim	ited.
DISTRIBUTION STATEMENT (of the abetract entered in Black 20, if different from Report) Supplementary notes Key words (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics Asstract (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic io will be studied to characterize the details of the process. Ion fragments		Wherene
Supplementary notes Key words (Continue on reverse side if necessary and identify by block number) multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics Asstract (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic io will be studied to characterize the details of the process. Ion fragments		DEC 20 19
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics **ASTRACT (Continuo en reverse side il necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ions, will be studied to characterize the details of the process. Ion fragments	7. DISTRIBUTION STATEMENT (of the abotract entered in Block 20, if different h	man Report)
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics **ASTRACT (Continuo en reverse side il necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ions, will be studied to characterize the details of the process. Ion fragments		ו וובוטולווו
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics **ASTRACT (Continuo en reverse side il necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ions, will be studied to characterize the details of the process. Ion fragments		OK D
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics **ASTRACT (Continuo en reverse side il necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic ions, will be studied to characterize the details of the process. Ion fragments		
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics O ANSTRACT (Continuo en reverse elde II necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic io will be studied to characterize the details of the process. Ion fragments	8. SUPPLEMENTARY NOTES	
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics O ANSTRACT (Continuo en reverse elde II necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic io will be studied to characterize the details of the process. Ion fragments		
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics O ANSTRACT (Continuo en reverse elde II necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic io will be studied to characterize the details of the process. Ion fragments		
multiphoton dissociation, polyatomic ions, infrared absorption, dissociation dynamics O ANSTRACT (Continuo en reverse elde II necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic io will be studied to characterize the details of the process. Ion fragments		
dissociation dynamics ASSTRACT (Continue on reverse side if necessary and identify by block number) The dynamics of multiphoton absorption and dissociation of polyatomic is will be studied to characterize the details of the process. Ion fragments		
The dynamics of multiphoton absorption and dissociation of polyatomic id will be studied to characterize the details of the process. Ion fragments		rared absorption,
The dynamics of multiphoton absorption and dissociation of polyatomic id will be studied to characterize the details of the process. Ion fragments	dissociation dynamics	
The dynamics of multiphoton absorption and dissociation of polyatomic id will be studied to characterize the details of the process. Ion fragments		
The dynamics of multiphoton absorption and dissociation of polyatomic id will be studied to characterize the details of the process. Ion fragments		
will be studied to characterize the details of the process. Ion fragments		
	The dynamics of multiphoton absorption and diss	ociation of polyatomic id

A single photon electronic transition in dissociation.

DD 1 1 1473 EDITION OF 1 NOV 65 IS OBSOLETE 410 281 Und as fied 1



December 4, 1978 MP 78-123

SUMMARY QUESTIONNAIRE

ONR Contract N00014-76-C-1035

Mechanisms of Multiphoton Dissociation of Molecular Ions

SRI Project PYU 5808



1. Contract Description

The dynamical details of the dissociation of molecular ions occurring by multiphoton absorption will be studied. Fragment identities will be determined as well as the average energy released into translation.

2. Scientific Problem

The multiphoton dissociation (MPD) of neutral polyatomic molecules has been shown to be an isotopically selective process whose energetics are governed by statistical principles. These conclusions are based upon detailed studies of the dissociation dynamics in collision free molecular beams. Similar information for polyatomic ions is unavailable, so that the mechanisms of MPD in ionic species remain to be determined.

Multiphoton processes are finding applications in isotope separation schemes, frequency conversion techniques and laser assisted chemistry. Elucidation of the detailed mechanisms involved was essential to the understanding and application of MPD to these problems in neutral environments, and will be of similar importance for ionic environments. In particular, if MPD of ions were to be non-statistical, then it might be possible to control the outcome of mode-specific ion-molecule reactions. Such mode-selective reactions would find wide applications in chemical synthesis and analysis. At present, however, neither the products produced from MPD of ions are known, nor are the energetics leading to fragmentation.

3. Scientific and Technical Approach

Positive or negative ions are produced in an electron impact source, then accelerated to 3 keV and mass analyzed to form a highly collimated beam. An electrostatic (quadrupole) field bends the ions through 90° where they are merged along a 40-cm path with the output from a grating tuned CO₂ TEA laser. Laser fluences of 1-50 J/cm² are available using a variety of focusing optics. Ion fragments will be energy analyzed using a second quadrupole field. Simple conservation principles will establish the mass of these fragments from a knowledge of the monoenergetic parent ion identity. Additional higher resolution energy analysis of the fragment ions using a hemispherical sector will provide a measure of the energy released into translation during dissociation. The energy resolution of this arrangement (\geq 50 meV) will allow an estimate to be made of the number of infrared photons absorbed beyond the dissociation limit. The coaxial beams spectrometer to be used has already demonstrated the necessary capabilities in studies of the visible photodissociation of molecular ions.

4. Progress

The previous contract period was devoted to a systematic search for infrared absorptions of simple molecular ions. These absorptions would provide information regarding the initial steps of multiphoton processes in ions. Using the same coaxial beams spectrometer, a CW CO₂ laser was employed as an excitation source. We attempted to identify the vibrational absorptions by their effect on either the visible photodissociation of positive ions or the visible photodetachment of negative ions. Despite a thorough search in a number of ions, no evidence was found for any such IR absorptions.

We did, however, observe IR absorption leading to the direct dissociation of highly vibrationally excited 0_2^+ ions. This process was shown to be a single photon absorption involving an electronic transition.

5. Publications

No publications have yet resulted from this work.

6. Extenuating Circumstances

None

7. Personnel

The following SRI personnel have participated in this work during the past year: M. J. Coggiola, P. C. Cosby, J. T. Moseley, J.-B. Ozenne, and J. R. Peterson. Dr. Ozenne participated in this work while a visiting scientist at SRI, on leave from the University of Paris, Orsay, France.

8. Graduate Student Degrees

No graduate students participated in this work.